PART B: RATE OF PROGRESS PLAN

4.0 1990 BASE YEAR INVENTORY

4.1 BACKGROUND

An inventory consists of emissions that occur during the peak ozone season, i,e., when outdoor air concentrations of ozone tend to be higher than the rest of the year. Pennsylvania's peak ozone season occurs during the months of June, July and August. Unless otherwise specified, any daily emissions given refer to a "typical" summer weekday and are given in tons per summer day (tpsd).

The CAAA (42 USCA Sec. 7511(a)(1)) requires states containing ozone nonattainment areas to develop a "comprehensive, accurate and current inventory of actual emissions from all sources." EPA interpreted "current" to mean an inventory for calendar year 1990. The submittal of a 1990 Base Year Emission Inventory was required in the November 15, 1992 set of SIP revisions. However, in September 1992, EPA concluded that the 1990 Base Year Emission Inventory must be subject to a public hearing process. Given the late decision, EPA allowed states until November 15, 1993 to complete the public hearing process and formally submit the 1990 Base Year Inventory as a SIP revision.

Public hearings on the 1990 Base Year Emission Inventory were held August 30, 31 and September 1, 1993. In addition, a public hearing was held on the 15% ROP plan, which included the 1990 inventory, on December 22, 1993. This plan was submitted to EPA on November 12, 1993; EPA deemed it incomplete. Public hearings on the revised plan, dated October 22, 1994, will be held on November 29, 1994.

The percentage reduction requirements for the post-1996 rate of progress plan are calculated from the 1990 Base Year Inventory after certain adjustments are made. These adjustments are discussed in more detail in Section 6.

4.2 GEOGRAPHY

The Commonwealth of Pennsylvania has more ozone nonattainment areas than any other state. Figure 4.1 shows these areas. The Philadelphia nonattainment area is classified as severe ozone nonattainment. The Pennsylvania portion of the Philadelphia Consolidated Metropolitan Statistical Area (CMSA) includes the counties of Bucks, Chester, Delaware, Montgomery and Philadelphia.

The Philadelphia CMSA is a multi-state area covering parts of New Jersey, Delaware and Maryland. This plan refers only to the five county Pennsylvania portion of the Philadelphia CMSA unless other counties are specified.

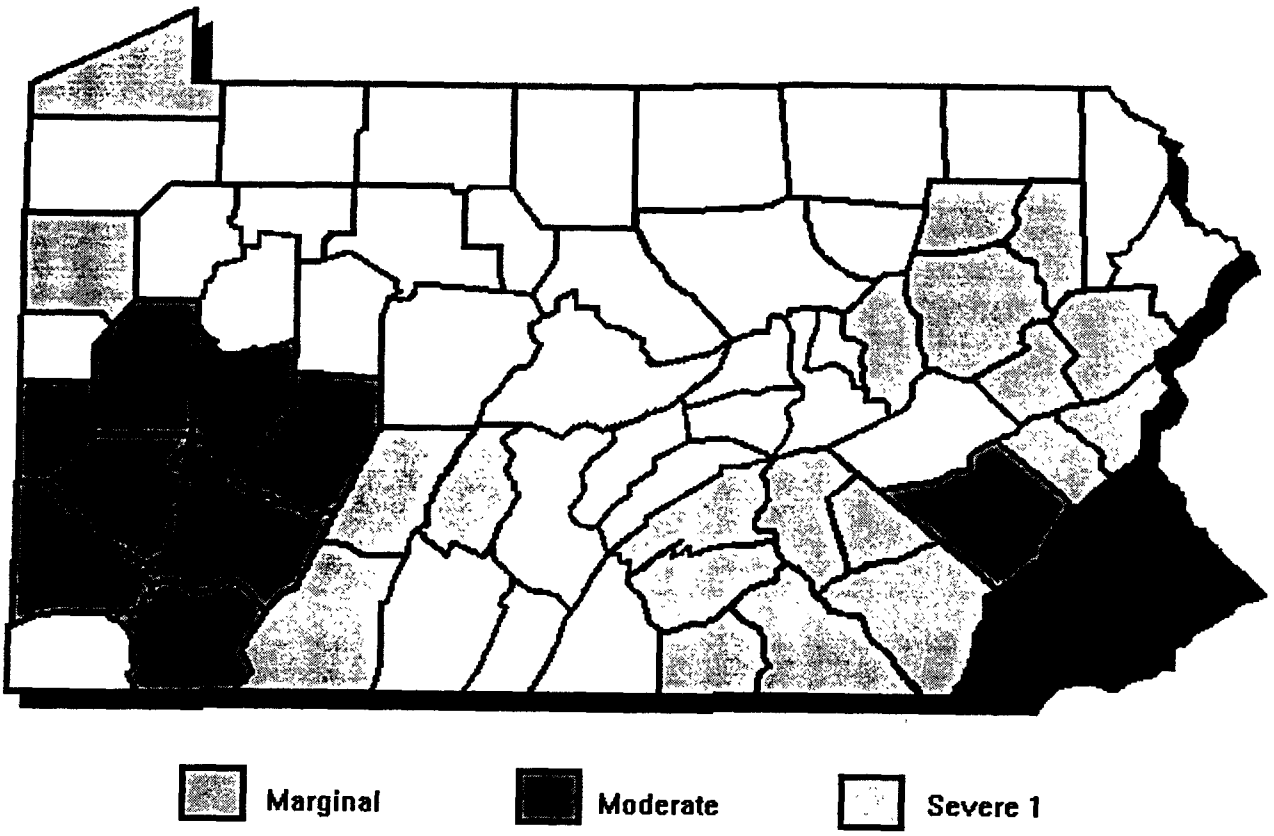

Figure 4.1 Pennsylvania Nonattainment Areas

4.3 SOURCE TYPES

The 1990 Base Year Inventory is a compilation of the emissions from sources of anthropogenic (human-made) VOC, biogenic (natural) VOC, sources of anthropogenic oxides of nitrogen (NOx) and carbon monoxide (CO) into the outdoor air. The sources are categorized into five components:

- Point sources
- Area sources
- Nonroad engine sources
- Highway vehicle sources
- Biogenic sources

4.3.1 POINT SOURCES

This section documents the development of the Pennsylvania stationary point source list and characterizes the point source component of the emission inventory by describing data collection, verification and emission estimation techniques. For purposes of this emission inventory, point sources are defined as stationary, commercial or industrial operations that emit more than ten tons per year of VOCs or 100 or more tons of NOx or CO per year. The point source inventory consists of actual emissions for the base year 1990 for the five county Philadelphia Area.

The Pennsylvania Department of Environmental Resources was the agency responsible for compiling the point source inventory. It was responsible for identifying point sources meeting the cutoff criteria, documenting the method used to calculate emissions from each source and summarizing and presenting its findings. Philadelphia Air Management Services compiled the point source inventory for Philadelphia with the results summarized herein.

The remainder of this point source section details the point source data collection techniques, the emission estimation procedures and provides more detailed tables of emission estimates.

A. COMPILING THE POINT SOURCE LIST

The data for the 1990 VOC, NOx and CO Point Source Emission Inventories was derived from the Pennsylvania Emissions Data System, PEDS. PEDS is the database from which the National Emissions Data System was compiled. PEDS sources are identified and inventoried by Pennsylvania regional air quality offices through permitting operations, and regional / central office field inspections and surveys. The PEDS system is designed to include all point source emissions categories for 10 ton per year emitters of VOC and 100 ton or greater emitters of

CO and NOx. Smaller point source emitters are reported in PEDS but to a less inclusive degree. Nonreactive compounds have been excluded from the inventory.

Smaller VOC emitters were discovered using EPA-450/4-91-016 Standard Industrial Classification (SIC) code procedures, the Toxic Release Inventory (TRI) data and through the efforts of field personnel. Potential 10 ton per year or greater emitters were investigated by field personnel and were entered into the PEDS database and are included in the baseline inventory where applicable.

B. THE EMISSIONS ESTIMATION PROCEDURE

Emission estimates for each point source on the final list were derived using SCC emission factors in most cases. The automatic features of the PEDS database which duplicate the automatic features of the Airs Facility Subsystem were used where possible. Material balance, AP-42 equations and stack test results were used in addition to SCC emission factor estimates. Rule effectiveness and seasonal adjustments were included in the emission estimates for applicable source categories where company operating schedule data were available to warrant such adjustments or where VOC, a SIP rule and a control device were involved. Operating schedule and seasonal temperature adjustments were used with refinery tank emissions and bulk gasoline storage facility emissions. Adjustments were also made where a company requested that they be done after reviewing the daily emission data in its final draft form. All companies listed as part of the baseline inventory received a copy of the detailed final draft inventory for their review and comment. All company comments were reviewed and requested daily emission changes were made where operating schedule data or seasonal temperature considerations were valid. Requests for seasonal adjustments are documented in the comment/response section of this inventory.

The following equations represent the calculations which were performed on every source that was downloaded from the PEDS database. These equations use only the potential and actual emissions, the annual throughput and days per year of operation obtained from the PEDS database:

$$LBSpu = \frac{POT \times 2000}{ANNtp}$$

$$RATEpd = \frac{ANNtp}{DPY}$$

$$EFF = \frac{POT - ACT}{POT}$$

$$O_3Day = (RATEpd \times LBSpu) \times (1 - (RE \times EFF))$$

Where:
EFF = Control Efficiency
POT = Potential Emissions (tons)
ACT = Actual Emissions (tons)
LBSpu = Emissions per Unit of Throughput (pounds)
ANNtp = Annual Throughput
RATEpd = Daily Throughput (pounds)
O_3Day = Ozone Season Daily Emissions (pounds)
DPY = Days per Year of Operation
RE = Rule Effectiveness (Applied only when "add-on" controls are used to achieve compliance.)

Sample Calculation:

POT =100tpy VOC
ACT=10tpy VOC
ANNtp=2000
DPY=250
RE=0.80 (*SIP regulation and control device involved, else RE = 1.0*)

$$LBSpu = \frac{100tpy \times 2000 \, lbs/ton}{2000units} = 100 \, lbs/unit$$

$$RATEpd = \frac{2000units}{250dpy} = 8.0 \, units/day$$

$$O_3Day = (100 \, lbs/unit \times 8.0 \, units/day) \times (1.0 - (.90 \times .80)) = 224.0 \, lbs/day$$

Each company listed in this inventory was mailed a copy of their inventory and calculation results along with instructions to verify or correct the data and notify this office of required changes. The data were mailed in conjunction with public announcements and public hearings in accordance with SIP procedures. The results of the above equations have been altered in response to a company's request for change where the company was able to produce evidence of more appropriate ozone season operating schedule or throughput data.

C. RESULTS

Emissions have been adjusted for seasonal variability and rule effectiveness and are depicted in the six major emissions categories, in accordance with EPA reporting requirements, in Table 4.1.

Table 4.1 Summary of 1990 Point Source VOC and NOx Emissions

VOC Sources	Bucks tpsd	Chester tpsd	Delaware tpsd	Montgomery tpsd	Philadelphia tpsd	
Storage, Transport and Marketing of VOCs	0.02	0.33	14.58	0.67	6.72	
Industrial Processes	1.32	1.26	16.50	3.26	17.72	
Industrial Surface Coating	18.69	6.12	32.95	1.90	9.70	
Other Solvent Use	1.54	10.62	2.99	1.85	1.46	
Waste Disposal	0.00	0.00	0.16	0.00	0.00	
Misc. Sources	0.35	1.09	1.52	0.10	2.29	
TOTAL:	**21.93**	**19.42**	**68.71**	**7.78**	**37.89**	
					CMSA VOC Total:	**155.73**
NOx Sources						
External Fuel Combustion	6.29	9.63	55.13	5.13	26.76	
Stationary Internal Combustior	3.31	11.65	5.29	0.60	1.98	
Other Combustion	0.00	0.01	0.02	0.04	0.36	
Industrial Processes	5.63	1.80	19.47	1.05	10.51	
TOTAL:	**15.23**	**23.08**	**79.91**	**6.81**	**39.61**	
					CMSA NOx Total:	**164.64**

4.3.2 AREA SOURCES

The area source inventory enables the Bureau of Air Quality Control (BAQC) to estimate emissions collectively for those sources that are too small or too numerous to be handled individually in the point source inventory. Considerable attention was given to the area source inventory, as significant quantities of volatile organic compound emissions will generally be associated with the area source categories. Historically, emissions from area sources have been underestimated because of the lack of appropriate inventory procedures or little emphasis on obtaining area source data.

A. METHODS FOR ESTIMATING AREA SOURCE ACTIVITY LEVELS AND EMISSIONS

Area source emissions are typically estimated by multiplying an emission factor by some known indicator or collective activity for each area source category at the county or equivalent level. Several methodologies were available for estimating area source activity levels and emissions. Estimates were derived by (1) treating area sources as point sources, (2) surveying local activity levels, (3) apportioning national or statewide activity levels to local inventory areas, (4) using per capita emission factors and (5) using emission per employee factors. Each approach has distinct advantages and disadvantages when used in the emission estimates, as discussed below.

Small sources that would normally be treated as area sources may be handled as point for several reasons. First, collective activity levels estimates may not be readily determinable for certain source categories. Bulk plants are an example of this. According to the Control Technique Guideline summary Appendix C, a typical gasoline bulk plant emits only 17 tons of VOC per year. This emission rate would normally be below the BAQC's point source cutoff level. However, because the area source procedures used for determining gasoline sales in an area will probably not yield an estimate of the amount of gasoline transferred through bulk plants, the BAQC needed to elicit this information from each plant by using point source procedures.

In some instances, collective activity level estimates for a given category were available from a local source. For example, the Pennsylvania Department of Transportation (PENNDOT) has data on the amount and types of paints used for traffic line painting in the inventoried area. Tax, highway, energy, and other state and local agency records were used to provide collective activity level estimates for other area source categories, such as gasoline sales.

If county wide activity level information was not available locally, state totals were apportioned to compute local estimates. For example, the quantity of highway gasoline used in the Commonwealth was apportioned to the county level on the basis of vehicle miles traveled per county. Residential, commercial, and industrial fuel combustion were other categories that were handled in this manner. The major drawbacks of this approach were that additional data and resources are needed to apportion activity levels to the local level, and accuracy is lost in the process. If state level data were not available, then national data were apportioned to the local inventory area.

Sources in certain area source categories were not only numerous and diffuse, but were too difficult to inventory by any of the above procedures. As an example, solvent evaporation from consumer and commercial products such as waxes, aerosol products and window cleaners cannot be routinely determined by the DER.. In addition, it would probably be impossible to develop a survey that would yield such information. The use of per capita emission factors is based on the assumption that, in a given area, emissions can be reasonably associated with population. This assumption is valid over broad areas for certain activities such as architectural surface coating, and selected solvent use categories, such as solvent evaporation from household and commercial products.

Many industrial and commercial sources had emissions estimated by using a per employee factor. This approach is conceptually equivalent to using per capita factors, except that employment was used as a surrogate activity level indicator rather than population. Emissions per employee factors are usually used to estimate emissions for those source categories for which a Standard Industrial Classification Code (SIC) has been assigned and employment data (typically by SIC) at the local level was available.

B. APPLICATION OF RULE EFFECTIVENESS (RE)

In previous inventories, it was assumed that regulations would be implemented with full effectiveness, achieving all of the intended emission reductions and maintaining that over time. However, experience has shown that regulatory programs are less than 100 percent effective for most source categories. The concept of applying RE in the inventory has evolved from this observation. In short, RE reflects the ability of a regulatory program to achieve all emission reductions that could be achieved by full compliance with the applicable regulation.

EPA chose an 80 percent factor as a representative estimate of the average effectiveness value for the base year inventory after surveying selected state and local personnel on the perceived effectiveness of their regulatory programs.

The RE factor should be applied to the estimated control efficiency in the calculation of emissions from a source. The formula for this application is given below:

$$Emissions = UCE \times (1 - (CE x RE))$$

where:
UCE = Uncontrolled emissions
CE = Control Efficiency
RE = Rule Effectiveness

C. APPLICATION OF RULE PENETRATION (RP)

In addition to RE, another important regulatory consideration is to what extent a regulation may affect emissions from a source category. Typically smaller sources in a category may not be covered by a regulation. For example, surface coating regulations do not cover sources less than 15 pounds of volatile organic compounds per day. When estimating emissions using area source methodologies for source categories where a rule or regulation applies, EPA suggests the incorporation of an estimate of RP using the following formula:

$$RP = \frac{UNC}{POT} \times 100$$

where:
UNC = Uncontrolled emissions covered by the regulation
POT = Potential emissions

After controlled emissions and RP are determined, RE should be applied as discussed above. An example of the formula showing how to incorporate both RP and RE in the same source category is given below:

$$EMIS = POT \times (1 - RP x RE \times CE)$$

where:
EMIS = Actual Emissions
POT = Potential Emissions
RP = Rule Penetration
RE = Rule Effectiveness
CE = Control Efficiency

The use of rule effectiveness and rule penetration can substantially increase emission estimates where high control efficiencies are involved.

D. RESULTS

The EPA approved methodology used to calculate each source category is included in Appendix III. These calculations result in Area Source emissions of 205 tons per summer day of VOCs and 48 tpsd of NOx. Table 4.2 Summerizes the results.

Table 4.2 Summary of Area Source VOC and NOx Emissions

VOC Sources	1990 Bucks *tpsd*	1990 Chester *tpsd*	1990 Delaware *tpsd*	1990 Montgomery *tpsd*	1990 Philadelphia *tpsd*	
Transportation	0.22	0.07	5.02	1.38	2.63	
Industrial Processes	15.80	11.04	12.51	33.86	36.74	
Combustion	0.44	0.31	0.47	0.59	1.41	
Gasoline Marketing	5.10	4.03	3.30	6.68	6.54	
Waste Disposal	0.86	1.61	1.05	9.29	9.22	
Consumer/ Commercia	4.78	3.33	4.84	5.99	13.78	
Misc. Evaporative	0.28	0.19	0.28	0.35	0.81	
Total:	**27.48**	**20.58**	**27.48**	**58.14**	**71.13**	
				CMSA VOC Total:		**204.81**
NOx Sources						
Transportation	2.50	0.83	4.23	4.56	12.66	
Combustion	2.87	1.97	3.16	4.35	9.11	
Waste Disposal	0.25	0.17	0.22	0.39	0.60	
Total:	**5.63**	**2.97**	**7.61**	**9.30**	**22.37**	
				CMSA NOx Total:		**47.88**

4.3.3 NONROAD ENGINE INVENTORY

A. INTRODUCTION

The "Other Non-road Engines and Vehicles" category includes a diverse collection of equipment such as lawn mowers, chain saws, recreational equipment, farm equipment and construction machinery. A study was conducted by the EPA in November 1991 of emissions from non-road engines and vehicles[1]. The study determined whether emissions from such sources cause, or significantly contribute to air pollution that may be anticipated to endanger public health or welfare.

B. METHODS

As part of the above study, EPA considered more than 80 different types of equipment. To simplify analysis and reporting, EPA grouped the equipment types into the 10 equipment categories listed below:

Lawn and Garden Equipment
Agricultural Equipment
Logging Equipment
Light Commercial Equipment
Industrial Equipment
Construction Equipment
Airport Service Equipment
Recreational Equipment
Recreational Marine Equipment
Commercial Marine Vessels.

Two emission inventories were developed for the first nine categories for 24 ozone and CO nonattainment areas across the country. The EPA then contracted with Energy and Environmental Analysis, Inc., (EEA) to update the non-road equipment and vehicle emission inventories based on the 1991 EPA-designated nonattainment boundaries for CO and ozone exceedance areas. These areas include the original 24 areas from the original non-road study and an additional nine areas. The 33 nonattainment areas all have had an inventory, designated as "Inventory A," prepared for them, based on commercially and publicly available data. Besides Inventory A, the original 24 areas have been provided with two more inventories. The second inventory, designated as "Inventory B," is based on confidential, industry-supplied sales and other data that are not publicly available. The second inventory provided EPA with a cross-check for the first inventory, and the results agreed reasonably well. Since the DER was not able to review the confidential data used to generate Inventory B, only Inventory A was used.

The following is a brief description of the procedures that were followed by the EEA in preparing the non-road emissions data that are being used for this inventory.

To construct the EPA non-road inventory, several factors were estimated: (1) equipment populations in the given nonattainment area; (2) annual hours of use of each type of equipment, adjusted for geographic region and for the season of interest for each pollutant studied; (3) average rated horsepower of each type of equipment; (4) typical load factor for each type of equipment; and (5) an emission factor for each of the 79 categories of equipment. In developing emissions inventories for non-road engines and vehicles, the EPA used the following formula to calculate emissions for most of the 79 non-road categories:

$$M_i = N \times HRS \times HP \times LF \times EF_i$$

where:

M_i = mass of emissions of i^{th} pollutant during inventory period
N = source population
HRS = annual hours of use
HP = average rated horsepower
LF = typical load factor
EF_i = average emissions of i^{th} pollutant per unit of use (e.g., emission factor grams per horsepower-hour)

The product of the annual hours of use, the average rated horsepower, and the load factor is referred to as the per-source usage rate. The product of the equipment population and the per-source usage rate is called the activity level and is estimated in units of horsepower-hours. By multiplying the seasonally adjusted activity levels by the appropriate emission factor, emission estimates for an ozone season day were developed for each category of non-road equipment and vehicles in the EPA-prepared inventories.

As outlined in an April 27, 1992, memorandum[2] from EPA to all EPA Regional Offices, the first option for States developing non-road engine and vehicle emission inventories is to simply use the inventory prepared by EPA for the particular nonattainment area for which an inventory is being developed. This option was selected for the counties in the Philadelphia CMSA. The ozone precursor emission estimates for the ozone season for the Philadelphia CMSA ozone nonattainment counties were taken directly from the EPA-supplied Inventory A for the Philadelphia CMSA.

C. RESULTS

The Philadelphia ozone nonattainment modeling domain emission estimates of 91 tons per day of VOCs and 78 tpsd of NOX were drawn from the spreadsheets, prepared by the EPA's Office of Mobile Sources, for the Philadelphia CMSA.

4.3.4 HIGHWAY VEHICLE SOURCES

A. INTRODUCTION

Highway vehicle emissions contribute a significant portion to Pennsylvania's emission inventory. This impact is due to both tailpipe and evaporative emissions from the traffic volumes experienced in both urban and surrounding areas. The Department of Environmental Resources has coordinated with the Pennsylvania Department of Transportation (PENNDOT) to develop the necessary data to produce highway vehicle emission estimates.

Pennsylvania's emission inventory includes the following vehicle classifications:

1.	LDGV	Light-Duty Gasoline Vehicles
2.	LDGT1	Light-Duty Gasoline Trucks (<6,500 lbs)
3.	LDGT2	Light-Duty Gasoline Trucks (<8,500 lbs)
4.	HDGV	Heavy-Duty Gasoline Vehicles (>8,500 lbs)
5.	LDDV	Light-Duty Diesel Vehicles
6.	LDDT	Light-Duty Diesel Trucks (<8,500 lbs)
7.	HDDV	Heavy-Duty Diesel Vehicles (>8,500 lbs)
8.	MC	Motorcycles

The inventory illustrates the individual county's emissions for each of the three pollutants. The data and methods presented in the inventory represent the Commonwealth's approach based on US EPA guidance[3].

The Mobile 5a Model was used for calculating emissions factors. It was supported by the Post Processor for Air Quality (PPAQ). PPAQ is a set of programs which analyzes network operating conditions, calculates highway segment speeds, compiles vehicle miles of travel (VMT) and vehicle type mix data, prepares mobile runs and calculates emissions quantities from the emission rates and VMT. The PPAQ Mobile System Layout is provided in Figure 4.5. PPAQ/Mobile System functions and input parameters are detailed in Appendix III.

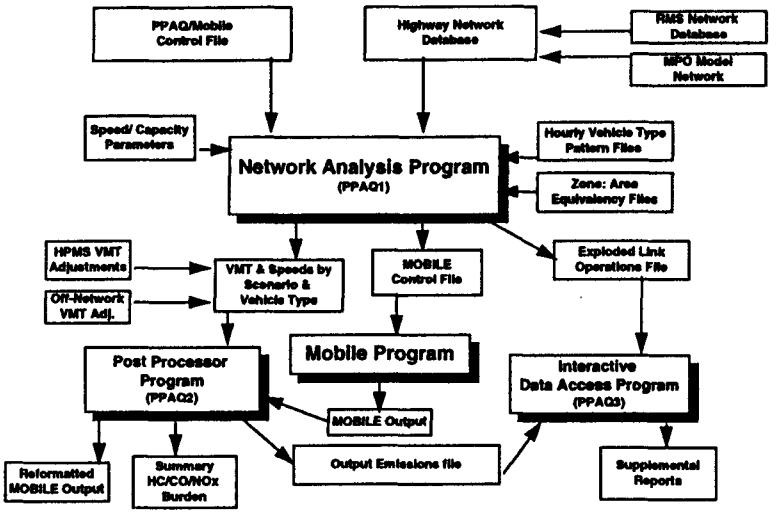

Figure 4.2 The PPAQ/Mobile5a System Layout

B. VMT ESTIMATION PROCEDURE

The Vehicle Miles Traveled (VMT) and speed data supplied by PENNDOT was compiled from the Highway Performance Monitoring System (HPMS). The data are classified into the following areas:

1. Urbanized
2. Small Urban
3. Rural

Each area is defined into functional road classifications:

1. Interstate
2. Other Freeways & Expressways (Urban & Small Urban)
3. Principle Arterials
4. Minor Arterials
5. Major Collectors
6. Minor Collectors
7. Local Roads

B.1 SOURCE OF VMT

The Roadway Management System (RMS) is maintained by PennDOT's Bureau of Transportation System Performance (BTPS). It contains each state highway segment including the Pennsylvania Turnpike, current traffic counts, truck percentages, and a variety of physical attributes of the segment. These data were extracted from RMS and compiled into a database for emissions calculation purposes.

Factors were calculated which adjust the 1990 RMS VMT to be consistent with HPMS totals, by county, area (Urban, Small-urban or Rural (USR)), and functional class. Adjustments for the "higher" functional classes were very close to 1.00, since HPMS VMT is derived from RMS. "Lower" classes (i.e. local roads) required greater adjustment, since a large part of the local system is not under state jurisdiction and is not in the RMS database. The state highway system does, however, contain a significant amount of local mileage; it was assumed that these local streets are representative of the local streets in their area with respect to volume and speed, so that a roadway mileage adjustment was appropriate.

Seasonal and daily adjustment factors have been developed by BTSP for traffic pattern regions and functional classes. These were applied to the 1990 average annual daily traffic (AADT) volumes to produce July 1990, average weekday traffic (AWDT) volumes on each segment. This adjusted volume then was the basis for the inventory and forecast runs.

B.2 AGGREGATION SCHEME

While highway volumes, vehicle mixes, and speeds are calculated on the basis of individual highway segment and hour, these data are far too disaggregate to apply directly to Mobile 5a. Instead, VMT and Vehicle Hours of Travel (VHT) are accumulated by larger geographic areas, highway functional class and time period. Geographic aggregation was performed by USR areas of each county. Functional class aggregation was according to PennDOT's 18 standard functional classes, respecting urban, small urban, and rural definitions. Time period aggregation was according to AM peak (6-9 am), PM peak (4-7 pm), midday (9 am-4 pm), and night (7 pm-6 am). For an individual county this creates a potential for 72 possible combinations, each of which becomes a Mobile scenario. This allows each Mobile scenario to represent the actual VMT mix, speed and (potentially) cold/hot start fraction for that geographic/highway/time combination.

B.3 VEHICLE TYPE MIX

The RMS database contains daily truck percentages on each highway segment, estimated from traffic counts. Additional pattern data assembled by BTSP was applied to generate the hourly distribution of trucks for different functional classes, plus the Mobile default type distribution was used to split the generic "trucks" category to the Mobile sub-vehicle types. For each link, then PPAQ calculates an hourly vehicle mix as a percentage of the hourly volume. The truck percentage is used to adjust highway capacity for speed estimation, as discussed below.

As VMT is accumulated to the geographic area / functional class / time period table, it is actually stratified by vehicle type. After all highway segments have been processed, then total and vehicle type VMT have been accumulated for each of the Mobile scenarios. Simple division then calculates the vehicle mix that is input to Mobile as part of each scenario's specification.

B.4 COLD vs. HOT START FRACTIONS

Mobile 5a default cold and hot start fractions of 20.6 and 27.3 percent respectively are used in all scenarios.

B.5 SPEED ESTIMATION

Physical attributes of each highway segment are contained in the database. These include functional class, number of lanes, and USR area type. Using this information the zero-volume speed and capacity of the segment are estimated. Truck percentage adjustments are then applied to produce an hourly capacity.

For functional classes which do not have control devices (i.e. freeways, expressways, and rural highways), a modified Bureau of Public Roads (BPR) formula with adjusted coefficients is used to calculate the speeds that will occur

for each hour on the segment. This speed reflects the traffic volume, vehicle mix, and physical segment characteristics.

For functional classes which do have control devices (i.e. urban arterials), an intersection approach model is used to simulate the effect of traffic signals on speed. For each type of facility (differentiated by functional class, number of lanes, and area type), key parameters such as average signal spacing, cycle length, green time, additional approach lanes, and progression factor are extracted from a lookup table. Using 1985 Highway Capacity Manual delay equations, the effect of traffic volume on traffic-signal delay is calculated and added to the link travel time calculated above.

The result of this process is, for each highway segment, an estimated average travel time and speed for each hour of the day. The average time is multiplied by volume to produce vehicle hours of travel (VHT). VHT is then accumulated for each of the above Mobile scenarios, and when complete an average speed for the scenario is calculated by dividing VMT by VHT. This, then, is the speed which is input to Mobile 5a.

B.6 TIME OF DAY AND DIURNAL EMISSIONS

The highway system VMT and speeds are aggregated according to four time periods. Because diurnal emissions are calculated by Mobile 5a on the basis of 24-hour minimum-to-maximum temperatures, special processing is needed to accurately estimate this emissions component by allocating daily diurnal emissions to the various time periods. In order to use this method, minimum and maximum temperatures are required for each of the four time periods, in addition to the minimum and maximum daily temperatures. Mobile 5a is then run at all five temperature ranges.

C. EMISSION FACTOR ESTIMATION PROCEDURE

The Mobile 5a model was the emission factor model used to generate the on-road inventory. A summary of the input data are included in Appendix III. Key assumptions and data to be used as input to the model are as follows:

- Speed - Input based on speed estimation (section B.5)
- Vehicle Mix - One mix for each scenario was applied based on the aggregation scheme (section B.2)
- Temperature - Reflects time of day variations upon actual weather station hourly data where the specific day was chosen according to EPA procedure.
- I/M - Program start year of 1984 for current I/M counties, 1995 for others.
- Pollutants - Emission factors for VOC's, CO, and NOx are produced for all the model runs.

- RVP - RVPs are set to be consistent with observed data in the Philadelphia region for the 1990 actual run. A value of 8.4 was used for the entire Philadelphia region. This values was then reset to 9.0 region-wide for the 1990 adjusted and 1996 projected baseline, and 8.7 for the 1996 proposed strategy. These are the default values required by where actual 1990 measured RVP data are not available.

D. RESULTS

The Results from the highway vehicle modeling show emissions of 188 tpsd VOC and 157 tpsd of NOx are summarized in table 4.3 and detailed in appendix IV. A detailed description of the reductions shown by the modeling can be found in section 7.4 of this document.

Table 4.3 1990 Highway Vehicle Emissions Summary

	Bucks	Chester	Delaware	Montgomery	Philadelphia	
	tpsd	*tpsd*	*tpsd*	*tpsd*	*tpsd*	
VOC Emissions						
LDGV	30.50	18.97	19.98	35.78	56.49	
LDGT1	1.54	0.96	0.93	1.96	2.73	
LDGT2	1.24	0.78	0.70	1.51	2.01	
HDGV	0.47	0.30	0.29	0.57	0.77	
LDDV	0.27	0.18	0.20	0.35	0.44	
LDDT	0.03	0.02	0.02	0.04	0.05	
HDDT	0.27	0.18	0.18	0.36	0.41	
MC	1.32	1.00	0.87	1.73	1.78	
TOTAL:	**35.64**	**22.38**	**23.16**	**42.30**	**64.70**	
				CMSA TOTAL:		188.17
NOx Emissions						
LDGV	24.99	19.94	14.39	30.42	32.84	
LDGT1	1.40	0.98	0.75	1.73	1.91	
LDGT2	1.08	0.75	0.55	1.30	1.41	
HDGV	0.45	0.33	0.25	0.55	0.57	
LDDV	0.98	0.78	0.60	1.26	1.24	
LDDT	0.10	0.07	0.06	0.13	0.14	
HDDT	2.99	2.10	1.74	3.88	3.95	
MC	0.18	0.15	0.10	0.23	0.19	
TOTAL:	**32.17**	**25.10**	**18.45**	**39.51**	**42.25**	
						157.48

5.0 THE 2005 PROJECTED INVENTORY

The CAAA[4] requires that ozone nonattainment areas classified as moderate and above achieve a 15 percent reduction in VOC emissions by 1996 and an additional 3 percent reduction each year until 2005 - a total reduction of 42 percent.. The reduction must be achieved from anthropogenic VOC emission levels reported in the state's 1990 Base Year Inventory after those levels have been adjusted downward to remove emission reductions achieved by the pre-1990 FMVCP and the use of 9.0 RVP gasoline. The 15% reduction plan must also offset the expected growth in VOC emissions between 1990 and 2005. Thus, the total necessary reduction from 1990 actual emissions is greater than 42 percent. The Base Year Inventory has been discussed in section 4. This section presents the 2005 Projection Year Inventory which is the state's estimation of the level of VOC and NOx emissions expected in 2005, assuming no new additional regulatory strategies.

5.1 GROWTH FACTOR METHODOLOGY - BEA

The Projected Year Inventory is developed by applying growth factors to the Base Year Inventory. Guidance from the EPA[5] suggests four typical indicators of growth. In order of priority, these are:

1. Product output
2. Value added
3. Earnings
4. Employment

Surrogate indicators of activity developed by a state, such as population, may also be acceptable methods. To meet the November 15, 1993 statutory deadline for the Rate of Progress Plan, DER was unable to explore alternate methods of projection for the Point, Area and Nonroad Inventories. The Bureau of Economic Analysis (BEA) provided projections[6] of income, employment and population from which appropriate growth factors were derived.

The BEA provides state specific historical data for 1973, 1979, 1983 and 1988 and projection estimations for 1995, 2000, 2005, 2010 and 2040 for each indicator it considers. We have not included 1973 and 1979 data in our analysis because the economic changes in Pennsylvania in those years create a nonlinear growth rate. Data for 2040 were also excluded because of a lack of confidence in the projections.

Since the BEA did not provide data for 1990 and 1996 these numbers are calculated by assuming a linear growth rate between the two closest years where

data exists (i.e. 1988, 1995 & 2000). For example, 1990 values are derived using the following formula:

$$IND90 = IND88 + (\frac{2}{7} \times (IND95 - IND88))$$

where:

IND?? = BEA value for the chosen category for the year ??

The data were then reviewed in comparison to the 1983, 2000 and 2005 data to verify that the assumption of linear growth was valid.

5.1.1 POINT SOURCE GROWTH CALCULATION

Growth in the point source inventory was calculated, without exception, based on growth in income. The BEA projects earnings growth in 57 industrial groups which can, for the most part, be matched to a two-digit Standard Industrial Classification (SIC) code.

The resulting growth factors are listed in Table 5.1. Table 5.2 is a summary of the 1996 Projected Point Source Inventory with no new controls applied.

Table 5.1 Point Source Growth Factors By SIC Code

2-Digit SIC Code	Source Description	Growth Factor	2-Digit SIC Code	Source Description	Growth Factor
01	Agricultural Production-crops	1.136	45	Transportation By Air	1.471
02	Agricultural Production-livestock & Animal Special	1.136	46	Pipelines, Except Natural Gas	1.094
07	Agricultural Services	1.414	47	Transportation Services	1.431
08	Forestry	1.414	48	Communications	1.202
09	Fishing, Hunting And Trapping	1.414	49	Electric, Gas And Sanitary Services	1.284
10	Metal Mining	1.063	50	Wholesale Trade-durable Goods	1.207
12	Coal Mining	0.957	51	Wholesale Trade-nondurable Goods	1.207
13	Oil And Gas Extraction	0.988	52	Building Materials, Hardware, Garden Supply	1.244
14	Mining And Quarrying Of Nonmetallic Minerals	1.220	53	General Merchandise Stores	1.244
15	Building Construction-general Contractors & Bldrs	1.165	54	Food Stores	1.244
16	Heavy Construction Other Than Bldg Constr-contract	1.165	55	Automotive Dealers And Gasoline Service Stations	1.244
17	Construction-special Trade Contractors	1.165	56	Apparel And Accessory Stores	1.244
20	Food And Kindred Products	1.065	57	Home Furniture, Furnishings & Equipment Stores	1.244
21	Tobacco Products	0.705	58	Eating And Drinking Places	1.244
22	Textile Mill Products	1.015	59	Miscellaneous Retail	1.244
23	Apparel & Other Finished Products Made From Fabric	1.015	60	Depository Institutions	1.266
24	Lumber & Wood Products, Except Furniture	1.343	61	Nondepository Credit Institutions	1.266
25	Furniture And Fixtures	1.275	62	Security & Commodity Brokers, Dealers, Exchanges	1.227
26	Paper And Allied Products	1.192	63	Insurance Carriers	1.336
27	Printing, Publishing And Allied Industries	1.264	64	Insurance Agents, Brokers And Service	1.336
28	Chemicals And Allied Products	1.119	65	Real Estate	1.604
29	Petroleum Refining And Related Industries	1.008	67	Holding And Other Investment Offices	1.227
30	Rubber And Miscellaneous Plastics Products	1.294	70	Hotels, Rooming Houses, Camps, ect.	1.369
31	Leather And Leather Products	0.954	72	Personal Services	1.218
32	Stone, Clay, Glass And Concrete Products	1.055	73	Business Services	1.724
33	Primary Metal Industries	0.816	75	Automotive Repair, Services & Parking	1.359
34	Fabricated Metal Products, Except Machinery & Tran	1.173	76	Miscellaneous Repair Services	1.724
35	Industrial And Commercial Machinery & Computer Equ	1.074	78	Motion Pictures	1.407
36	Electronic & Other Electrical Equipment & Componen	0.955	79	Amusement And Recreation Services	1.407
37	Transportation Equipment	1.125	80	Health Services	1.460
38	Measuring, Analyzing & Controlling Instruments	1.174	81	Legal Services	1.595
42	Motor Freight Transportation And Warehousing	1.194	82	Educational Services	1.252
44	Water Transportation	0.865	89	Services Not Elsewhere Classified	1.344

Source: BEA Regional Projections to 2040, U.S. Dept. of Commerce, June 1990

Table 5.2 Summary of 2005 Point Source VOC and NOx Emissions (no new controls)

VOC Sources	Bucks tpsd	Chester tpsd	Delaware tpsd	Montgomery tpsd	Philadelphia tpsd	
Storage, Transport and Marketing of VOCs	0.00	0.11	14.40	0.42	7.52	
Industrial Processes	1.52	1.32	16.61	3.96	18.81	
Industrial Surface Coating	28.38	8.22	35.68	2.03	10.86	
Other Solvent Use	1.92	18.00	3.40	2.01	1.54	
Waste Disposal	0.00	0.00	0.04	0.01	0.00	
Misc. Sources	0.42	0.64	1.66	0.12	2.45	
TOTAL:	**32.25**	**28.30**	**71.80**	**8.55**	**41.18**	
					CMSA VOC Total:	**182.07**
NOx Sources						
External Fuel Combustion	5.87	12.17	67.99	5.94	30.93	
Stationary Internal Combustior	4.24	14.91	5.87	0.67	2.53	
Other Combustion	0.00	0.01	0.02	0.05	0.36	
Industrial Processes	5.16	1.75	19.80	1.10	10.61	
TOTAL:	**15.26**	**28.84**	**93.69**	**7.75**	**44.44**	
					CMSA NOx Total:	**189.98**

5.1.2 AREA SOURCE GROWTH CALCULATION

With the exception of gasoline marketing operations, the area source inventory was projected based on BEA data. In most cases, the factors used were those of employment or population growth. Although guidance from EPA suggested that population or employment alone were not necessarily adequate indicators of emissions growth in comparison to income or value added growth, the DER found they were the best choice.

The area source inventory is based primarily on employment and population emission factors. Thus emissions are calculated using a factor of a given number of pounds of pollutant per employee or per person. As this is the EPA approved method for calculating emissions to determine the Base Year Inventory, consistency dictates their use, where available, in projected year inventories. Other areas, such as air transport, where emissions are based on a measurable activity level were considered on an individual basis and the best available factor was selected. See Table 5.3 for a comparison of activity indicators and growth indicators for area sources. The resulting growth factors, after applying the equation given in section 5.1, are detailed in Table 5.4. These factors were used to project the 2005 uncontrolled emissions - see Table 5.5.

Table 5.3 Area Source Activity and Growth Indicators

Source Category	Activity Indicator	Indicator of Growth
Transportation		
RAILROADS	Fuel Consumption	Railroad Employment
AIRCRAFT	LTO Cycles	Air Transport Employment
VESSELS	Fuel Consumption	Water Trans. Employment
Industrial Processes		
Surface Coating:		
AUTO REFINISH	Employment	Population
TRAFFIC LINE P	Population	Population
FACTORY FI WOOD	Employment	Durable Mfg. Employment
METAL FURN & FIX	Employment	Durable Mfg. Employment
ARCHITECT	Population	Population
ELECT INS	Employment	Durable Mfg. Employment
METAL CANS	Employment	Fabricated Metal Employment.
MISC FI METALS	Employment	Fabricated Metal Employment.
MACH & EQUIP	Employment	Nonelectric Machine Mfg. Employment
APPLIANCES	Employment	Electric Machine Mfg. Employment
MOTOR VEH	Employment	Motor Vehical Employment
OTHER TRANS	Employment	Transportation Employment
MARINE	Employment	Durable Mfg. Employment
MISC MANU	Employment	Durable Mfg. Employment
HIGH PERF	Population	Durable Mfg. Employment
OTHER SPEC COAT	Population	Durable Mfg. Employment
Other Industrial:		
PESTICIDES	Land area	Farm Employment
BIOPROCESS	Production	Population
GRAPHIC ARTS	Population	Printing & Publishing Employment
OFFSHORE	Population	No Growth Projected
DEGREASING	Employment	Durable Mfg. Employment

Source Category	Activity Indicator	Indicator of Growth
Combustion		
FUEL OIL COMB	Fuel Consumption	Population
COAL CON (RES)	Fuel Consumption	Population
NAT'L GAS & LPG	Fuel Consumption	Population
STRUCTURE FIRE	Number of Fires	No Growth Projected
FOREST FIRES	Number of Fires	No Growth Projected
ORCHARD HEAT	Population	Population
Gasoline Marketing		
VOC-NO STAGE I	Fuel Sales	VMT
STAGE I	Fuel Sales	VMT
STAGE II	Fuel Sales	VMT
TANK BREATH	Fuel Sales	VMT
AIRCRAFT REFUEL	Fuel Sales	Air Transport Employment
Waste Disposal		
SOLID WASTE LF	Throughput	Population
POTW	Throughput	Population
OPEN BURNING	Throughput	Population
SOLID WASTE INC	Throughput	Population
Consumer/ Commercial		
DRY CLEANING	Population	Population
COMM/CONSUM	Population	Population
Misc. Evaporative		
ASPHALT	Populaion	Population
LUST	Number of Tanks	Population
CATASTROPHIC	Individual Records	No Growth Projected

Table 5.4 Pennsylvania Area Source Growth Factors

Category	1983	1988	1990	1995	1996	1999	2000	2002	2005	'90-'05 Growth
Air Trans. Emp.	11.2	16.4	17.4	19.9	20.3	21.3	21.7	22.1	22.8	1.310
Auto Repair Emp.	49.8	65.4	67.6	73.2	74.2	77.0	78.0	79.3	81.2	1.201
Chemical Mfg. Emp.	58.1	60.1	59.8	59.2	59.2	59.1	59.1	58.8	58.4	0.976
Construction Emp.	233.9	319.2	323.1	332.9	334.8	340.4	342.3	344.0	346.5	1.072
Durable Mfg. Emp.	637.6	621.7	615.2	598.9	596.8	590.7	588.6	584.0	577.1	0.938
Electric Mach. Emp.	106.7	94.3	91.4	84.3	83.3	80.3	79.3	77.8	75.6	0.827
Fabricated Metal Emp.	87.9	94.9	95.5	97.1	97.3	97.7	97.9	97.5	96.9	1.014
Farm Employment	95.1	90.1	89.1	86.6	86.2	85.0	84.6	83.6	82.2	0.923
Food Mfg. Emp.	91.0	91.9	91.6	90.8	90.7	90.4	90.3	89.5	88.4	0.965
Furniture Employment	19.4	22.5	22.9	24.0	24.2	24.9	25.1	25.4	25.8	1.125
Lumber Prod. Emp.	22.5	35.3	36.4	39.1	39.6	41.0	41.5	42.1	43.0	1.182
Motor Vehicle Emp.	24.6	25.1	24.8	24.2	24.1	23.7	23.6	23.4	23.0	0.926
Nondurable Mfg. Emp.	480.6	460.5	458.2	452.5	452.3	451.7	451.5	449.1	445.4	0.972
Nonelectric Mach. Emp.	109.3	109.4	108.4	105.9	105.4	104.1	103.6	102.9	101.9	0.940
Petroleum Prod. Emp.	14.9	10.5	10.4	10.0	10.0	9.8	9.8	9.7	9.5	0.917
Primary Metal Emp.	121.0	91.3	87.5	78.0	76.8	73.2	72.0	70.0	67.0	0.766
Printing & Publish. Emp.	75.1	87.7	89.3	93.4	94.1	96.3	97.0	97.8	99.1	1.109
Railroad Employment	22.7	18.3	17.4	15.3	15.1	14.4	14.2	13.8	13.3	0.762
Retail Trade Emp.	910	1038	1056	1100	1110	1138	1148	1158	1174	1.112
Total Pop. (in thousands)	11895	12001	12091	12316	12356	12475	12515	12597	12719	1.052
Transportation Emp.	35.8	37.3	37.1	36.6	36.6	36.5	36.5	36.3	36.1	0.973
Water Trans. Emp.	7.1	5.1	5.0	4.6	4.6	4.4	4.4	4.3	4.2	0.847
Wholesale Trade Emp.	254.7	286.4	291.5	304.4	306.4	312.2	314.2	317.1	321.4	1.102

Table 5.5 Summary of 2005 Area Source VOC and NOx Emissions

VOC Sources	1990 Bucks *tpsd*	1990 Chester *tpsd*	1990 Delaware *tpsd*	1990 Montgomery *tpsd*	1990 Philadelphia *tpsd*	
Transportation	0.23	0.09	7.53	1.99	3.33	
Industrial Processes	17.89	13.05	14.60	32.61	39.60	
Combustion	0.56	0.40	0.60	0.75	1.78	
Gasoline Marketing	6.71	5.30	4.35	8.79	8.61	
Waste Disposal	1.10	2.48	1.47	14.75	12.79	
Consumer/ Commercia	5.17	3.60	5.24	6.48	14.91	
Misc. Evaporative	0.40	0.28	0.40	0.50	1.17	
Total:	**32.05**	**25.20**	**34.18**	**65.87**	**82.18**	
					CMSA VOC Total:	**239.48**
NOx Sources						
Transportation	2.47	0.85	4.89	5.05	15.24	
Combustion	3.66	2.52	4.03	5.55	11.61	
Waste Disposal	0.33	0.22	0.29	0.51	0.79	
Total:	**6.47**	**3.58**	**9.21**	**11.11**	**27.64**	
					CMSA NOx Total:	**58.01**

5.1.3 NONROAD ENGINE GROWTH CALCULATION

Growth in emissions from nonroad engines was calculated using the same methodology used for the area sources. Table 5.6 compares the activity level indicators used by the EPA with the growth indicators used here for projection. Table 5.7 details the projected uncontrolled 2005 VOC emissions of 96 tpsd. The NOx emissions in 2005 are projected to be 82 tpsd.

Table 5.6 Comparison of Activity Level Indicators vs. Growth Indicators for Nonroad Engines

Category	Activity Indicator	Growth Indicator	'90-'96 Growth Factor
Lawn and Garden Equipment	Single Family Homes and Landscaping Emp.	Population	1.052
Airport Service Equipment	Aircraft Operations	Employment	1.31
Recreational Equipment	Establishments in SIC 557 (Motorcycle Dealers)	Population	1.052
Recreational Marine Equipment	Boat Registration and Water Area	Population	1.052
Light Commercial Equipment	Wholesale Trade Establishments	Employment	0.938
Industrial Equipment	Employment	Employment	0.938
Construction Equipment	Employment	Employment	1.072
Agricultural Equipment	Employment	Employment	0.923
Logging Equipment	Logging Establishments	Employment	1.182

Table 5.7 The 2005 Uncontrolled Nonroad Engine VOC Inventory

Category	Bucks	Chester	Delaware	Montgomery	Philadelphia
Lawn and Garden	8.56	6.77	6.91	12.26	14.83
Airport Equipment	0.00	0.00	0.00	0.00	1.11
Recreational Equipment	0.45	0.57	0.00	0.00	0.00
Recreational Vessels	6.81	3.57	4.49	4.93	3.29
Light Commercial Equipment	0.99	0.78	0.76	1.82	1.79
Industrial Equipment	0.72	0.47	0.55	1.36	1.37
Construction Equipment	1.48	1.11	1.30	2.67	2.42
Agricultural Equipment	0.46	0.68	0.02	0.30	0.00
Logging Equipment	0.11	0.13	0.04	0.13	0.01
Total	**19.58**	**14.09**	**14.07**	**23.46**	**24.83**
					CMSA Total: **96.02**

5.2 HIGHWAY VEHICLE EMISSIONS GROWTH

Highway vehicle emissions growth and, in the area source category, gasoline marketing growth are projected (see Table 5.8) based on the projected increase in Vehicle Miles Traveled (VMT). This projection was derived from a Traffic Demand Model (TDM) and the Post Processor for Air Quality (PPAQ). For more information see sections 7.4 and 7.4.4.

Table 5.8 Projected 2005 Highway VOC Inventory

	Bucks	Chester	Delaware	Montgomery	Philadelphia	
	tpsd	*tpsd*	*tpsd*	*tpsd*	*tpsd*	
LDGV	32.88	20.88	21.76	36.94	47.16	
LDGT1	1.31	1.05	0.86	1.65	1.88	
LDGT2	1.01	0.81	0.62	1.22	1.35	
HDGV	0.27	0.22	0.18	0.33	0.36	
LDDV	0.28	0.20	0.19	0.34	0.37	
LDDT	0.03	0.02	0.02	0.04	0.04	
HDDT	0.22	0.19	0.16	0.30	0.29	
MC	1.42	1.18	0.96	1.82	1.62	
TOTAL:	**37.42**	**24.55**	**24.75**	**42.63**	**53.08**	
					CMSA Total:	**182.43**

6.0 EMISSION REDUCTION REQUIREMENTS

42 U.S.C.A. §7511(b)(1) requires that severe ozone nonattainment areas achieve a three percent per year reduction in emissions of VOCs from 1996 to 2005, the year air quality standards must be met. The reduction must be achieved from anthropogenic VOC emission levels reported in the state's 1990 Base Year Inventory after those levels have been adjusted downward to remove emission reductions achieved by the pre-1990 FMVCP and the use of 9.0 RVP gasoline. Those reductions are averaged over consecutive 3 year period, creating a de facto requirement of a 9 percent reduction every three years.

The CAAA required nonattainment areas classified as moderate and above to submit a ROP plan demonstrating that a 15% reduction in VOCs between 1990 and 1996 will be achieved. Therefore, the total required reduction in VOCs required by 2005 from 1990 Base Year Inventory levels is 42% which includes a 15% reduction between 1990 and 1996 and an additional 27% for the nine years 1997-2005.

The 15% ROP plan includes measures sufficient to achieve the required reduction plus excess reductions that, along with NOx substitution, fulfill the requirement for contingency measures sufficient to achieve an additional 3% reduction.

The post-1996 ROP plan is to include measures mandated by the CAAA and other additional measures the state finds necessary both to achieve the required reduction and to offset projected growth between 1996 and 2005. All measures, whether mandatory or optional, must produce "real, permanent, and enforceable" emission reductions if those reductions are to be counted toward meeting the reduction requirements[7].

Equivalent reductions in NOx achieved between 1990 and 2005 may be substituted, on a percentage basis for reductions in VOC.

6.1 CALCULATION OF THE REDUCTION TARGET

VOC emissions in the five county Philadelphia area must be reduced by 357 tons per day (tpd), not including growth offsets, to comply with the mandate to reduce net anthropogenic VOC emissions by 42 percent between 1990 and 2005. This amount was arrived at through the following calculation.

1. A 1990 Baseline Inventory was created by removing biogenic emissions and perchloroethlyene[8] (Perc.) Compounds from the 1990 Base Year Emission Inventory.
2. Reductions from the Federal Motor Vehicle Control Program (FMVCP) and RVP were subtracted from the 1990 Baseline Inventory[9]. This produced the Adjusted Baseline Inventory.

3. The Adjusted Baseline inventory was multiplied by 42 percent. This produced the amount of the required 42 percent emission reduction by 2005.
4. The 1990 Base Year Inventory for Point Sources was reviewed to determine where Reasonably Available Control Technology (RACT) "fix-up" emission reductions would apply. RACT "fix-ups" are defined as post-1990 corrections made to pre-1990 RACT regulations.
5. The required reductions and reductions from from the FMVCP, RVP and RACT fix-ups[10] were subtracted from the 1990 adjusted baseline. This produced the emission target level for 2005, which is 343 tpsd of VOC.

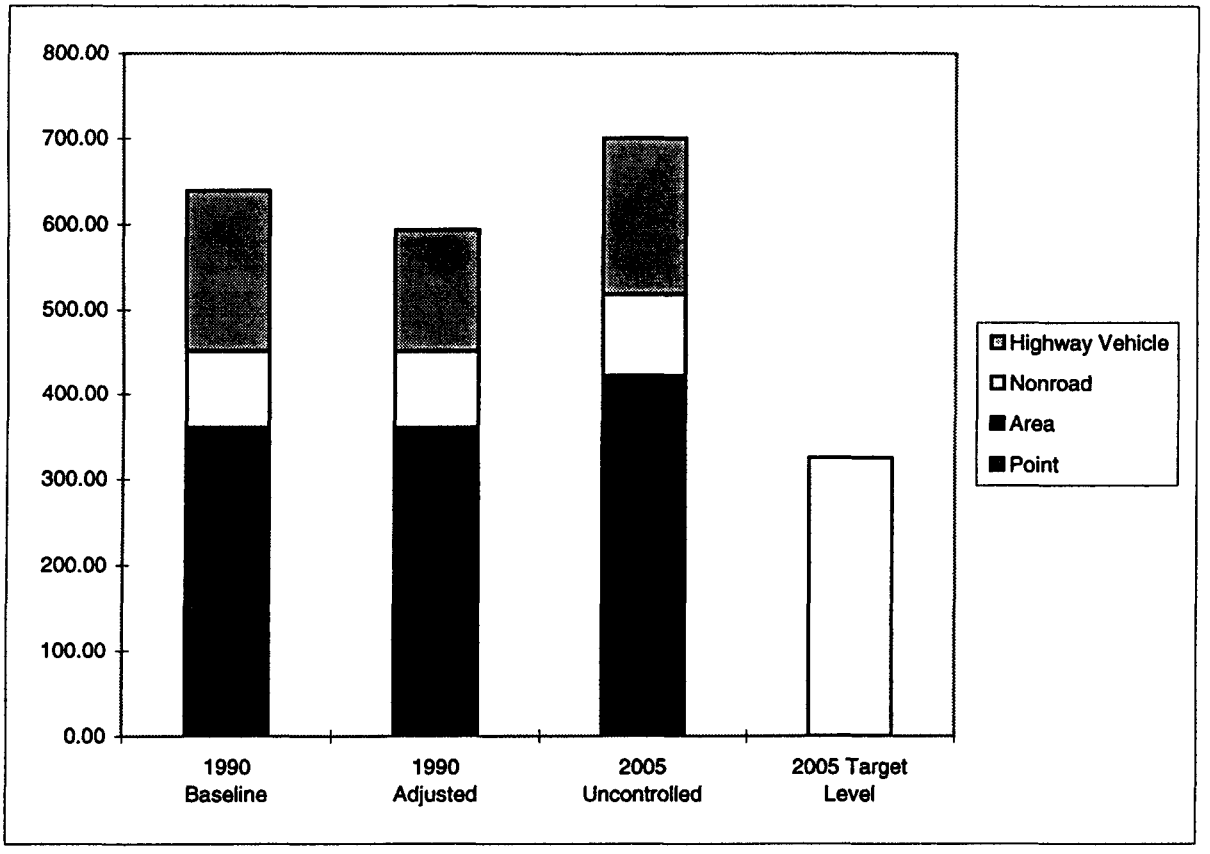

Figure 6.1 VOC Inventory Summary With the 2005 Target Level

6.2 ACCOUNTING FOR GROWTH IN EMISSIONS

The CAAA not only requires that severe nonattainment areas achieve a three percent annual reduction in VOC levels from 1990 levels after 1996, but also requires that the post-1996 rate of progress plan provide for the offset of expected growth in VOC emissions that occurs between 1990 and 2005. This section summarizes growth in emissions calculated using the methodologies described in Section 5. 61 tons per day were added to the 1990 Base Line inventory to create the 2005 Projected Inventory. When the 2005 emission target level was compared with the 2005 Projected Emission Inventory, a shortfall of 357 tons per day in the ozone season was determined. Pennsylvania must eliminate this shortfall between 1990 and 2005, to ensure compliance with the emission reduction requirements of the Act. Table 6.1 details these calculations.

Table 6.1 The Post 1996 Rate of Progress Plan

Source Category	1990 Baseline *tpsd*	FMVCP/ RVP *tpsd*	1990 Adjusted *tpsd*	42% Reduction *tpsd*	RACT Fix-ups *tpsd*	2005 Target Level *tpsd*	'90 - '05 Growth *tpsd*	2005 Uncontrolled *tpsd*
Point	155.73		155.73				26.34	182.07
Area	204.81		204.81				34.67	239.48
Nonroad	90.60		90.60				5.42	96.02
Highway Vehicle	188.17	45.81	142.36				-5.74	182.43
TOTAL	**639.31**	**45.81**	**593.50**	**249.27**	**0.84**	**343.39**	**60.69**	**700.00**

6.3 RATE OF PROGRESS PLAN SUMMARY

In the previous sections a need for a reduction of 357 tons of VOC per summer day was demonstrated. To meet this requirement Pennsylvania expects to achieve emissions reductions of 202 tons per day of VOC and 142 tpsd of NOx.

To convert the actual NOx reduction of 142 tpsd to a creditable VOC reduction the following formula was used:

$$R_{VOC} = VOCbase \times \left(\frac{R_{NOx}}{NOxbase} \right)$$

$$R_{VOC} = 639.31 \, tons/day \times \left(\frac{141.95 \, tons/day}{447.84 \, tons/day} \right)$$

R_{VOC} = 198.35 tpsd
Where:
RVOC = Reduction in VOC
RNOx = Reduction in NOx
VOCbase = 1990 Adjusted Baseline VOC emissions
NOXbase = 1990 Adjusted Baseline NOx emissions

This results in a creditable reduction of 198 tpsd VOC. when this is added to the actual VOC reductions of 202 it results in a total creditable reduction of 400 tpsd. This exceeds the required reductions by 43 tpsd.

The measures used to achieve the above reduction can be classified as Federally mandated measures, pending Federal programs or State and local initiatives. Federally mandated measures are control programs that were clearly mandated by the Clean Air Act. These measures make up the majority of the necessary emissions reductions. Pending federal programs and state and local initiatives are also critical to achieving a 42% reduction. Table 6.2 summarizes expected reductions from these sources.

The comparison between the 1990 Baseline, 1990 Adjusted Baseline, 2005 Uncontrolled and 2005 Controlled inventories is shown in figure 6.2.

Table 6.2 Expected Reductions

VOC Control Stratagy	tpsd
I/M 240 Program	81.38
Federal Reformulated Gasoline	38.54
FMVCP & Tier 1	7.68
Employee Trip Reduction (ETR)	1.00
Stage II Vapor Recovery	18.64
VOC RACT	1.86
Improved Rule Effectiveness	24.62
Federal AIM Regulations	6.35
Facility Shutdowns	3.88
Consumer Products	6.97
Autobody Refinishing	6.22
Traffic Line Painting	1.57
TSDF Controls	3.13
Total VOC Reductions	**201.84**

NOx Control Stratagy	tpsd
Highway Vehicle Reductions	51.21
Facility Shutdowns	3.96
Industrial/Utility Boilers	86.78
Total NOx Reductions	**141.95**

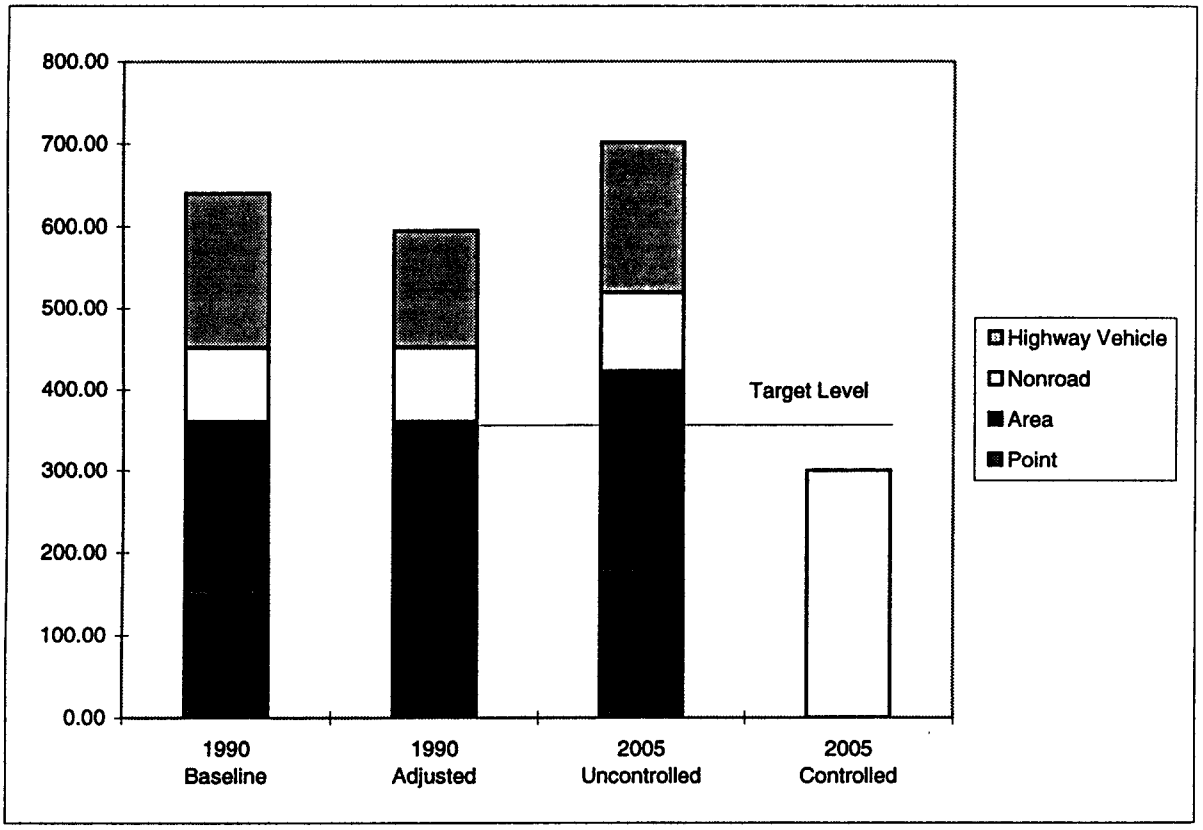

Figure 6.2 VOC Inventory Summary With NOx Substitution in 2005

7.0 THE CONTROL MEASURES

This section provides a detailed description of the control measures Pennsylvania will use to meet the Reasonable Further Progress (RFP) requirement.

Both VOC and NOx Reductions are listed in this section. NOx reductions are expressed in actual ton of NOx reduced - not in equivalent tons of VOCs. The procedure to convert NOx reductions to creditable VOC reductions was detailed in section 6.0.

7.1 POINT SOURCE CONTROLS

7.1.1 REASONABLY AVAILABLE CONTROL TECHNOLOGY (RACT)

Background:

The CAAA require states to adopt regulatory programs mandating that Major Stationary Sources (MSSs) of VOCs and NOx located in the ozone nonattainment areas implement RACT control strategies. These RACT control efforts are to be completed by the affected sources as expeditiously as practicable but no later than May 31, 1995. The RACT requirements apply both to sources affected by the provisions of Control Techniques Guidance (CTG) documents issued by EPA and to other major stationary sources. In the Philadelphia ozone nonattainment area, a MSS is one that has the "potential to emit" either NOx or VOC at a rate equal to or greater than 25 tons per year.

RACT is a generic term which includes the variety of controls which are available for use to reduce emissions from a source or class of sources and which are cost effective. EPA has issued CTGs for approximately 25 to 30 classes of sources of VOCs and plans to issue approximately 15 additional CTGs for VOC. The Commonwealth has adopted regulations incorporating the CTG requirements for the classes of sources that are represented in Pennsylvania or has submitted permits as revisions to the state implementation plan (SIP) for affected sources. In a series of regulatory revisions in the early 1990s, the Commonwealth made the CAAA mandated "RACT fix-ups."

EPA has not issued CTGs to define RACT controls for sources of NOx and does not plan to issue NOx CTGs. However, EPA has issued a number of Available Control Techniques (ACT) Guidance documents for certain classes of NOx sources. These ACT guidance documents differ from the CTG documents in that the ACTs do not define a presumptive norm for the control requirement as do the CTGs.

Implementation:

Because of the wide variety of MSS classes and the disparate ages of the sources located in the Commonwealth, Pennsylvania has determined that the preferred approach to regulation of MSSs of VOC and NOx for which CTG-based regulations are not in place is through a "case-by-case" RACT regulatory program. MSSs will develop analyses of available technologies for the reduction of the affected pollutants, submit the analyses to the Department of Environmental Resources for review, approval, or modification, and will implement approved RACT plans by May 31, 1995. The case-by-case determinations will be incorporated as revisions to the Pennsylvania SIP. For details on the Pennsylvania RACT Program refer to 25 Pa. Code §129.91-129.95.

Target Reductions:
The Department has estimated emission reductions from the case-by-case RACT program affected sources of VOC in the Philadelphia ozone nonattainment area. Certain emission reductions are claimed for sources which have implemented VOC emission reduction programs in advance of the finalization of the RACT regulatory program, but since 1990. Reductions of 1.02 tpsd were quantified in the 15% plan - addidtional reductions are expected, but not assumed in this plan. When the .84 tons per day is included from the previously identified RACT "fix-ups", the result is a total reduction of 1.86 tpsd of VOC.

The individual sources of RACT reductions are listed in The Proposed SIP Revision for Meeting the 15 Percent Rate of Progress Requirement Under the Clean Air Act in the Philadelphia Severe Nonattainment Area (also known as the 15% plan for Philadelphia.)

7.1.2 IMPROVED RULE EFFECTIVENESS (RE)

Background:
This measure involves enhancing rule compliance by increasing or, in other ways, improving the enforcement of an existing rule.

The projected emission reductions are based on an RE increase from 80 to 90% which yields a 10% improvement in RE. The amount of creditable reductions identified in this plan were calculated using this 10% improvement as applied to the sources specified in the attached plan at their inventory emission levels. Calculations using the proposed matrix measures, however, show that improvements well in excess of 10% will result from this initiative.

To estimate creditable emission reductions from RE improvements, state and local agencies require a method to quantify the predicted RE increase. The methodology must measure the impact of specific improvement measures available to a state or local agency. In the absence of any compliance or emissions

data to quantitatively assess RE improvement measures, EPA's Ozone/Carbon Monoxide Programs branch developed an RE matrix[14]. The RE matrix is based on a questionnaire that the EPA used to estimate base rule effectiveness for source categories. The following principles guided the development of the matrix.

- All state and local agencies should be guaranteed at least 80% base RE.
- State and local agencies with an RE well above the 80% default should receive more emission reduction credit for an RE improvement.
- RE improvements should be documented in a permit or in a SIP.
- percent RE is achieved in cases of direct determinations of emissions or elimination of VOCs or other pollutants through an irreversible process.

The matrix is divided into thirteen categories representing the range of activities and conditions that influence rule effectiveness. The 13 categories are:

1. Training of Plant Operators
2. Inspector Training
3. Educational Opportunities for Source
4. Procedures for Operation and Maintenance
5. Clarity of Testing Procedures and Schedules
6. Rule Effectiveness Evaluation Program
7. Monitoring
8. Type of Inspection
9. Administrative Authority - Prison
10. Administrative Authority - Fines
11. Administrative Authority - Citations
12. Media Publication of Enforcement Actions
13. Follow-up Inspections

The matrix includes subcategories for six of these categories. Control measures, which are the most specific in the matrix, are arranged in descending order, with the first measure having the most significant impact on RE.

Implementation:
In order to achieve creditable rule effectiveness (RE) improvement emission reductions the following items include the necessary commitments and describe the plan and those actions which are currently planned or in progress.

The Department will implement this plan and achieve at least a 24.62 tpsd reduction. The plan contains the selected matrix measures to be implemented and sufficient affected sources to achieve the planned reduction. Preliminary calculations using the planned measures indicate an average RE of over 94% (see calculation in plan). This will result in reductions in excess of the emission

reduction being used for credit in the 15% plan which can be credited to future 3% RFP requirements.The Department will execute an Single Source Category Determination (SSCD) protocol study to verify the RE improvements by 1996.

The matrix measures listed in the plan are the minimum items to be implemented. This includes changes to Department procedures, plans and work practices, and the incorporation of measures through appropriate permit revisions at the sources identified in the plan. All the measures will be implemented prior to the protocol study.

The matrix measures were conservatively selected, each are fully implementable; for instance, for those measures requiring increased field inspections, the staff resources are available, staff work plans can readily incorporate these activities and adequate records can be maintained to indicate that the required inspections took place.

Additional measures are possible. These are also identified, but were not included in the initial calculation of the expected 94% RE. These measures will also be implemented where feasible. The addition of such measures, along with the fact that the currently planned measures indicates an RE of over 94%, will ensure that the projected RE will equal or exceed the 94% level. Additionally, the sources identified in the plan constitute a preliminary set of affected sources; however, applicability is not necessarily limited to these sources. Additional sources may be added to achieve additional emissions reductions.

The following is an outline of the RE improvement plan:

Actions/Schedule:

- Select matrix measures and identify affected sources-*Completed.* However, more measures and sources will be added as practicable.
- Plan development-*Completed.* Several meetings were held with the regional staff in order to develop the plan. The regional operations staff (field inspectors) was provided with background on RE and the proposed plan, including the SSCD. Matrix measures were selected in a collaborative effort. Affected sources were contacted to ensure feasibility of implementing those measures which would affect them directly.
- Implement matrix measures-*In progress.* Measures will be added to permits and Department work plans. Each facility measure will be incorporated into Title V facility permits. Department measures, as listed, will be implemented by the Department. Documentation will be incorporated into training and operating plans.
- SSCD- *In progress.* Initial contact with EPA Region III completed. Contact with EPA SSCD section must be made and a schedule and specific protocol

devised and agreed to which assures completion of the study in time to demonstrate the reductions by the November 1996 deadline. This plan should be developed in the Spring of 1995.

Matrix/Measures:
Selected measures for upgrade actions as contained in the EPA's matrix. *{matrix item reference identification}*

1. **Facility Measures** - to be added to permit conditions. (will affect 100% of plant emissions):

A. Training of plant operators
Require formal operator introductory operator training course of 41-80 hours. *{A.1.b.}*
Require operators to take annual refresher training annually of 25-40 hours. *{A.1.c}*
Require appraisal and update of training program every 4 or more years. *{A.3.c}*

B. Procedures for operation and maintenance of control and/or process equipment.
Have equipment operators follow and sign daily O&M instructions. *{D.a.}*

C. Monitoring.
Require source specific enhanced monitoring procedures with a detailed self-evaluation schedule and use these data for compliance purposes. *{G.1.a.}*
Enhanced monitoring records filed with agency every 4-6 months. *{G.2.b}*

2. Department Measures:

A. Inspector Training
Formal inspector introductory courses, more than 80 hours. *{B.1.a.}*
Receive source-specific, inspector -refresher course with annual hours averaging 41-80 hours. *{B.2.a}*
Frequency with which appraisal and update training program is held for inspectors, every six months to a year. *{B.3.b}*
B. Rule Effectiveness Evaluation Program
Highest level category specific rule monitoring and evaluation, SSCD protocol study. *{F.1.a}*
Highest level of follow-up from rule monitoring and evaluation, rule corrections made based on SSCD protocol study result. *{F.2.a}*

3. Potential additional measures - not included in preliminary calculation or plan:

A. Clarity of testing procedures and schedules

Specific guidelines on testing and test method requirements and frequency schedule. *{E.1.a}*

B. Educational opportunities for sources

Frequency in years of workshops held by regulatory authority for industry on regulatory requirements, every year to two years. *{C.1.c}*

Frequency in years with which information packages on regulatory requirements are sent by the regulatory authority to sources, every year to two years. *{C.2.c}*

C. Types of Inspection

Level 3: detailed engineering analysis of process parameters, internal inspection of process and/or control devices. *{H.1.b}*

Target Reductions:

Calculation Of Projected RE And Reductions:

The following calculations are done in accordance with EPA manual EPA 452/R-94-001, *Rule Effectiveness Guidance: Integration of Inventory, Compliance, and Assessment Applications*, Page 4-10, section 4.5 Example was followed. The matrix equation/methodology calculation provides a number representing the increase in RE.

Definitions:

The Rule Effectiveness Raw Score (RERS) is defined as:

$$RERS = \sum_{G=1}^{n} \{G(x_s) \sum_{F=1}^{m} [F(t,G(x_s),f)] - [F(t,G(x_s),o) \times y(t,o)]\}$$

Where:

$G(x_s)$ = Weight assigned to subcategory s of matrix category x

$F(t,G(x_s))$ = Weight assigned to measure t of subcatagory s

$F(t,G(x_s),o)$ = Value of measure t of subcatagory s *before* RE improvement is implemented

$F(t,G(x_s),f)$ = Value of measure t of subcatagory s *after* RE improvement is implemented

$y(t,o)$ = Emissions corresponding to facilities implementing measure t as a % of the total emissions from a source category *before* improvement is implemented, where applicable, or 1

$z(t,f)$ = Emissions corresponding to facilities implementing measure t as a % of the total emissions from a source category *after* improvement is implemented, where applicable, or 1

Example:

$G(A_1) = 9$
$F(e(A_1)) = 1$
$F(b(A_1)) = 8$
$F(e(A_1),o) = F(e(A_1))\times 100\% = 1$
$F(e,b(A_1),f) = [F(b(A_1)\times 100\%)] + [F(e)(A_1)\times 0\%] = 8$
$F(e,b\ (A_1),f) - F(e(A_1),o) = 8 - 1 = 7$

Using the RERS equation the value to be summed with the other measures is:
$7\times G(A_1) = 63$,
Similarly,
$G(A_2) = 28$
$G(A_3) = 7$
$G(B_1) = 81$
$G(B_2) = 42$
$G(B_3) = 30$
$G(C_1) = 6$
$G(C_2) = 6$
$G(D) = 180$
$G(E) = 153$
$G(F_1) = 36$
$G(F_2) = 36$
$G(G_1) = 135$
$G(G_2) = 80$
$G(H) = 147$
$G(I) = 56$
$G(J_1) = 48$
$G(J_2) = 36$
$G(K) = 99$
$G(L) = 0$
$\underline{G(M) = 0}$
$RERS = 1269$

$RE(o) = 80\%$
$RERS = 1269$
$RERS(max) = 1818$

$RE(i) = (100\% - 80\%) \times (1269/1818) = 14.0\%$

$RE(f) = 80\% + 14.0\% = 94.0\%$

Calculation of the emission reduction should use the formula (4) on page 4-6 of the EPA guidance manual. However, it is in error (see Memo from John Silvasi for explanation). The correct method requires that the inventory method of calculating RE be used for RE_o and RE_f. Therefore, since the Department used the RE emissions calculation method from page 3-5, section 3.1.3.3 "Applying RE" which stated that:

RE emissions = Uncontrolled emissions × (1-(CE/100 × RE/100)

The reduction is thus equal to:

RE_f emissions at 94% RE-RE_o emissions at 80% RE

Each facility was calculated using its permitted CE and a 94% RE, the calculations resulted in an emission reduction of 24.62 tons per day of VOC. No reductions in NOx have been quantified

Sample Calculation:
Source ID# 22-19035180

$$RE_o \ Emissions = 0.4 \times (1 - \left(\frac{95}{100} \times \frac{80}{100}\right)) = 0.10$$

$$RE_f \ Emissions = 0.4 \times (1 - \left(\frac{95}{100} \times \frac{90}{100}\right)) = 0.06$$

RE Emissions = RE_o - RE_f = 0.10-0.06 = 0.04

7.1.3 SOURCE AND PROCESS SHUTDOWNS

Background:
Several sources which were operational in the 1990 and were included in the inventory have since shutdown.

Sources that did not apply to bank emission reduction credited (ERCs) within the regulatory deadlines established in 25 Pa. Code § 127.207(2), and therefore the listed reductions can be credited as permanent and enforceable emissions decreases.

In addition, Pennsylvania regulations require a 1.3:1 offset ratio for banked emissions. Therefore, sources that have banked emissions under the provisions of 25 Pa. Code 127(E) may use no more than 70% of these emissions at a later date. The remaining 30% are permanent reductions.

Table 7.1 lists the reduction generated from source or process shutdowns, and their status as banked or unbanked. This results in emission reductions of 3.884 tpsd of VOC

Table7.1 VOC Reductions From Facilities Reporting Shutdowns

Company	County	NEDS ID	Tpsd Reduction	Banked	Credit
Rohm & Haas	Bucks	0009	0.12	Yes	0.04
Fasson Div. of Avery Prod.	Bucks	0040	0.14	Yes	0.04
Minnesota Mining & Mfg.	Bucks	0056	2.40	Yes	0.72
Quebecor Printing	Chester	0009	0.16	Yes	0.05
Reynolds Metals	Chester	0046	0.09	Yes	0.03
Sun R&M	Delaware	0025	0.08	Yes	0.02
B.P. Oil Inc	Delaware	0030	0.41	Yes	0.12
Congoleum Corp.	Delaware	0049	0.89	Yes	0.27
Phila. Textile Finishers	Montgomery	0024	1.29	No	1.29
Rohm & Haas	Philadelphia	1531	0.16	No	0.16
Allied Chemical	Philadelphia	1551	0.39	No	0.39
Crown Cork & Seal	Philadelphia	1555	0.10	Yes	0.03
Progress Lighting Co.	Philadelphia	1584	0.01	Yes	0.00
Kurz-Hastings Inc.	Philadelphia	1585	0.04	No	0.04
Acme Markets	Philadelphia	2002	0.01	Yes	0.00
G. Spruance Co.	Philadelphia	2062	0.02	Yes	0.00
S.K.F	Philadelphia	2067	0.14	No	0.14
Container Recyclers Ltd.	Philadelphia	5112	0.06	No	0.06
Quality Container Corp.	Philadelphia	5116	0.08	No	0.08
U.S. Naval Base	Philadelphia	5811	0.38	No	0.38
				Total:	**3.88**

Several companies have banked NOx emissions in accordance with 25 Pa. Code 127(E) They are listed in the table 7.2 below.

Table 7.2 Facilities Banking NOx Emissions Reductions

Company Name	Tons NOx Banked
U.S. Steel Fairless Hill	1420.06
Martin Marietta Astro Space	6.78
Wyeth-Ayerst Labs	18.55
Marck Company Inc.	.21
Total	1445.6

This is equivalent to 3.96 tpsd of emissions. After the offset ratio is applied, a 1.19 tpsd reduction in NOx Results.
The above reductions result in a total creditable reduction of 1.67 tpsd.

7.1.4 OTC STATIONARY SOURCE NOX CONTROL

Background:
The Ozone Transport Commission adopted a Memorandum Of Understanding (MOU) on a stationary sources NOx control strategy that requires reductions in NOx emissions from 1990 levels from 250 MMBtu and larger fossil fired indirect heat transfer units and caps the aggregate total emissions from 15MW electric generating units at the 1990 level.

Implementation:
The memorandum specified the timing and level of reductions. Regulations implementing the MOU are to be promulgated by June 1995.

An emissions budget will be completed by March 1, 1995 to establish the reduction baseline. This baseline is to establish the five month control period baseline emissions from which each unit will be required to make the specified reduction on an aggregate basis (trading is permitted).

The reductions are scheduled to occur in two phases. Phase II will require a 55% or 0.2 LB/MMBtu reduction,whichever is less stringent, as applied to 1990 actual emission in the outer zone (all of the state except the Philadelphia nonattainment area and Berks county, the inner zone), and a 65% or 0.2 LB/MMBTU, whichever is less stringent, reduction in the inner zone by May 1, 1999. Phase III will, unless amended after findings that alternative reductions are necessary for attainment,

require a statewide 75% or 0.15 LB/MMBtu, whichever is less stringent, equivalent reduction by May 1, 2003.

The strategy also requires that 15 MW and above electric generating units on the aggregate basis be capped at 1990 levels to prevent load shifting and resultant uncontrolled emission increases. The inhibition of emissions growth was not factored into this measure.

Target Reductions:
The emission decrease was calculated by applying the least stringent of the 0.15 or 75% reduction requirement to each of the units in the 1990 inventory. The results of the calculation are contained in the emission tables. The total emission reduction is 86.78 tpsd

7.2 AREA SOURCE CONTROLS

7.2.1 ARCHITECTURAL AND INDUSTRIAL MAINTENANCE COATINGS

Background:
The CAAA require the EPA to adopt regulations for certain coatings. The ongoing national regulatory negotiation for Architectural and Industrial Maintenance (AIM) coatings is in the process of defining the final requirement.

AIM coatings are field-applied coatings used by industry, contractors and home owners to coat houses, buildings, highway surfaces and industrial equipment for decorative and protective purposes. The different types of coatings include flat, non-flat and numerous specialty coatings. VOC reductions result from the evaporation of solvents from the coatings during application and drying.

Because the category consists primarily of non-shop-applied coatings, the only technically and economically feasible control strategies involve product reformulation. This can involve one or more of the following approaches:

- Replacing VOC solvents with non-reactive substitutes.
- Increasing the amount of solids.
- Altering the chemistry of the resin so less
- solvent is needed for the required viscosity.
- Switching to waterborne latex or a water soluble
- resin system.

Implementation:
This is a pending federal measure.

Target Reductions:
Based upon EPA guidance[15], an emissions reduction of 15 percent could be applied towards the requirements for the Rate of Progress plan. The reductions were calculated as follows:

$$Reduction = 2005proj \times 15\%$$

The projected emissions were summed from the categories of Architectural Coatings, Special Purpose Coatings and High Performance Coating. This resulted in a 42.31 ton per day VOC projection and, from the above equation, an 6.347 ton creditable VOC reduction.
The EPA expects to publish a final rule by late 1995.

7.2.2 STAGE II VAPOR RECOVERY

Background:
This Federally mandated measure involves the installation of Stage II vapor recovery nozzles at gasoline pumps. This will reduce emissions of vapors in the fuel tank that are displaced by incoming gasoline.

Implementation:
Implementation of Stage II vapor recovery systems in the five county Philadelphia area was mandated in section 6.7(e) of the Air Pollution Control Act (35 P.S. § 4005(a)(1)). See also 25 Pa. Code §129.82.

Uncontrolled emissions for refueling emissions has an emission factor of 11.7 lbs. per 1000 gallons, according to Appendix IV of AP42. Fuel sales for 1990 for the Commonwealth of Pennsylvania were provided by the Department of Revenue. The fuel sales were apportioned by county based on the percentage of VMT of the county to the state, projected to 2005 based on growth in VMT expected by PENNDOT.

Table 7.3 Projected Fuel Sales

County	1990 VMT	2005 VMT	% Increase	1990 Fuel Sales	2005 Fuel Sales
Bucks	12,850,047	15,633,913	17.81	665,511	784,016
Chester	10,147,864	13,776,807	26.34	525,563	664,001
Delaware	8,279,044	10,678,188	22.47	428,776	525,112
Montgomery	16,839,970	20,560,212	18.09	872,151	1,029,961
Philadelphia	16,485,462	17,562,262	6.13	853,791	906,140
Total	64,602,387	78,211,382	17.40	3,345,792	3,927,969

Mobile 5a was used to determine the emission factor for controlled Stage II. The assumptions were 95% Rule Penetration and 80% Rule Effectiveness. This produce an 76% efficiency which was used as an input along with the start year of 1993 and a phase in period of 2 years into the Mobile 5a input file of the 1996 Projected Control Strategy. The emission factor from the model was 1.18 grams per gallon of VOCs which converts to 2.605 lbs/1000 gal.

Target Reductions:
Based on the following calculations, the emission reductions expected from the Pennsylvania Stage II program are 18.64 tpsd VOC.
Emission Factor Calculation:

$$EF_{no\ Stage\ II} = \frac{11.7 lbs}{1000 gal}$$

$$Efficiency = RE \times RP = .80 \times .95 = 76\%$$

$$EF_{Stage\ II} = 1.18\ {}^{g}\!/_{gal} \times \frac{kg}{1000 g} \times 2.205\ {}^{lbs}\!/_{kg} = \frac{2.602 lbs}{1000 gal}$$

Emission Reduction Calculation

$$05Emis_{No\ Stage\ II} = EF_{No\ Stage\ II} \times Gallons\ Sold_{2005\ Daily}$$

$$= 11.7\ {}^{lbs}\!/_{1000 gal} \times 3{,}927{,}969\ gal \times \frac{1 ton}{2000 lbs} = 22.98 tons$$

$$05Emis_{Stage\ II} = EF_{Stage\ II} \times Gallons\ Sold_{2005\ daily}$$

$$= 2.206\ {}^{lbs}\!/_{1000 gal} \times 3{,}927{,}969\ gal \times \frac{1 ton}{2000 lbs} = 4.33 tons$$

7.2.3 TREATMENT STORAGE and DISPOSAL FACILITIES

Background:
Treatment storage and disposal facilities (TSDFs) manage hazardous wastes containing VOCs and hazardous air pollutants (HAPs). These facilities manage dilute wastewaters, organic and inorganic sludges and organic and inorganic solids. The waste disposal is accomplished by incineration, land treatment, underground injection or landfills.

Implementation:
Federal measure.

Target Reductions:

Phase I standards were promulgated on June 21, 1990. The proposed Phase II standards would control emissions by 94%. This expected control level with an 80% rule effectiveness factor was used to calculate the 1996 emissions reduction. This results in a reduction of 3.13 tpsd VOC. Reductions between 1996 and 2005 have not yet been quantified, so no additional reductions are being claimed.

7.2.4 AUTOBODY REFINISHING

Background:
The EPA is in the process of adopting regulations controlling emissions from coatings used in autobody refinishing.

These coatings are, typically, shop-applied coatings used by industry, small businesses and vehicle owners to repair or recondition vehicles. VOC emissions result from the evaporation of solvents from the coatings during the following steps:

- Surface Preparation
- Surface Coating Application
- Cleaning of Application Equipment

There are several methods currently available to reduce emissions. The VOC content of surface preparation products is approximately 6.75 lbs/gal. There are products available with VOC levels below 1.7 lbs/gal. Similar reductions are also feasible from the reformulation of the surface coatings, including sealers and topcoats. High transfer efficiency spray systems has been shown to reduce emissions by 20-40%. Another technique is to install spray-gun cleaning equipment at body shops - this has been shown to reduce equipment cleaning emissions by 88%, and is already in use in many autobody repair shops.

The pending federal measure targets the surface coatings. These are responsible for approximately 70% of the emissions in this source category.

Implementation:
This is a pending federal measure.

Target Reductions:
Reductions from the reformulation of surface coatings are expected to be at least 35%. After application of the default rule effectiveness factor, a 28% reduction should be applied towards the requirements for the Rate of Progress plan. The reductions were calculated as follows:

Percent reduction: 35%

Default Rule Effectiveness (RE): 80%
$Creditable\ reductions = R \times RE = 35\% \times 80\% = 28\%$

Projected emissions of 18.34 tpsd VOCs were taken from the 1996 uncontrolled area source inventory. When the 28% reduction factor is applied, as shown in the above equation, 5.14 tpsd VOCs creditable reduction is achieved. Reductions between 1996 and 2005 have not yet been quantified, so no additional reductions are being claimed

7.2.5 CONSUMER PRODUCTS

Background:
The EPA is in the process of adopting regulations controlling emissions from consumer products. These include items sold for household, personal and automotive use that contain VOCs. There are several definitions of consumer products. For the purpose of the pending federal measure they are considered to be any VOC containing products in one of the previously mentioned categories, with the exception of aerosol paints.

This category is, geographically, highly disbursed. There are still several effective alternatives for controlling emissions from this category. These include:

- Product Reformulation
- Use of non-VOC Propellants (including CO2, compressed air and HFC-152a)
- Use of alternative delivery systems (i.e. handpumps or solids)
- Product Substitution

Implementation:
This is a pending federal measure.

Target Reductions:
Reductions from this measure are expected to be at least 25%. After application of the default rule effectiveness factor, a 20% reduction should be applied towards the requirements for the Rate of Progress plan. The reductions were calculated as follows:

Percent Reduction: 25%
Default Rule Effectiveness (RE): 80%
$Creditable\ \text{Re}ductions = R \times RE = 25\% \times 80\% = 20\%$

Projected emissions of 33.41 were taken from the 1996 uncontrolled area source inventory. When the 20% reduction factor is applied, as shown in the above equation, 6.68 tpsd creditable reduction in VOCs is achieved. Reductions between 1996 and 2005 have not yet been quantified, so no additional reductions are being claimed

7.2.6 HIGHWAY MARKING WATER BASE CONVERSION

Background:
The estimates for traffic marking VOC emissions are based on population numbers. Included in these estimates are all pavement marking activities. One portion of this activity, highway markings, is exclusively conducted by the Pennsylvania Department of Transportation (PENNDOT). The Department has quantified its use of VOC for this purpose in 1990 within the five county nonattainment area. A conversion to water base paint was completed in 1994. The Department has consented to permanently continue its use of water base paints capped at the 1994 level.

Implementation:
This measure required that emission levels were verified by the PENNDOT labs and field staff. A consent agreement will be executed to ensure the reduction is permanent.

Target Reductions:
The reduction is based solvent usage, painting season and average work-day patterns provided by PENNDOT. For planning purpose, PENNDOT assumes its painting crews work for a 100 day painting season.

Table 7.4 Highway Marking Solvent Usage

1990 Highway Marking Paint Usage

Paint Type	**lbs/gal VOC**	**Usage**	**VOC tpy**
White	3	66000	99
Yellow	3.05	95000	145

1996 Projected Highway Marking Paint Usage

Paint Type	**lbs/gal VOC**	**Usage**	**VOC tpy**
White	.83	64000	26.5
Yellow	1.4	87000	61

Daily Emissions = Annual Emissions/Days of Usage
Daily Emissions$_{1990}$ = 244/100 = 2.44tpsd
Daily Emissions$_{1996}$ = 87.5/100 = .875tpsd

Reduction = Daily Emissions$_{1990}$ - Daily Emissions$_{1996}$
= 2.44tpsd - .875tpsd
= 1.565tpsd

The Solvent The total reduction is 1.55 tons per summer day of VOC. Reductions between 1996 and 2005 have not yet been quantified, so no additional reductions are being claimed

7.3 NONROAD ENGINE CONTROLS

7.3.1 EFFECTS OF REFORMULATED GASOLINE ON NONROAD EMISSIONS

Background:
The use of reformulated gasoline also reduces emissions from nonroad engines. Federal phase 1 reformulated gasoline has, in an ASTM class "C" area, a RVP of 7.8 psi compared to the 9.0 psi RVP assumed in the nonroad calculation methodology.

Implementation:
See section 5.4.3 concerning implementation of the federal reformulated gasoline requirements.

Target Reductions:
This results in a 3.3% reduction in exhaust emissions and a 3.5% reduction in evaporative emissions[11] from two and four stroke gasoline engines.

These reductions were taken from the EPA provided evaporative and exhaust emissions resulting in reductions of .59 tpsd of VOC and no significant NOx reduction. No adjustments were made for double counting of refueling emissions and emission reductions in the nonroad and area source categories since most types of nonroad equipment are not refueled at gas stations.

7.3.2 PROPOSED EPA NONROAD ENGINE STANDARDS

Background:
Guidance is expected on creditable reductions from the proposed EPA regulations regarding Nonroad engines. The regulations will result in reductions in both VOC and NOx. When these regulations are adopted, DER will include these reductions, where necessary, in our milestone compliance demonstrations and maintenance plans. However, no expected reductions are being assumed at this time.

7.4 TRANSPORTATION CONTROL MEASURES AND STRATEGIES

This section presents VOC reductions by stratagy. A total reduction of 51tpsd in NOx was modeled using the same methodology. To date, the additional modeling necessary to depict this total by individual stratagy has not been completed .

7.4.1 THE FEDERAL MOTOR VEHICLE CONTROL PROGRAM (FMVCP) AND TIER I NEW VEHICLE EMISSIONS STANDARDS

Background:
The Act requires new Federal motor vehicle emissions standards, called "Tier I Standards", to be phased in beginning in the 1994 model year. This program will be implemented by the Federal government and will affect light duty vehicles and trucks.

This program will require more stringent exhaust emission standards as well as a uniform level of evaporative emission controls, demonstrated through the new Federal evaporative test procedures. The Tier I exhaust standards are to be phased in beginning with model year 1994.

Implementation:
This is a federally implemented measure.

Target Reductions:
Emissions reductions from this program are estimated to be 8 tons of VOCs per day. The Mobile 5a model automatically applies these controls unless the input file has been modified to disable the CAAA tailpipe standards and the evaporative test procedure. Beginning with the 1994 model year, vehicles available to the consumer will have been certified to meet these federal Tier I emission standards.

7.4.2 ENHANCED VEHICLE INSPECTION AND MAINTENANCE (E I/M)

Background:
This measure involves implementing a vehicle inspection and maintenance program with requirements stricter than the current "basic" program. This measure affects gasoline powered motor vehicles, 1968 and newer, with a gross vehicle weight less than 9,001 lbs.

Implementation:
In the E I/M program, tailpipe emissions will be measured over a transient driving cycle conducted on a dynamometer, which provides a much better indication of

actual on-road vehicle performance than existing idle tests. In addition, evaporative emission control equipment will be checked for function and integrity resulting in large emission reductions not achieved with the existing program.

The Pennsylvania program is a centralized, test-only I/M-240 program required once every 2 years. Additional details of the program can be found in 67 Pa. Code §178.

Target Reductions:
Using the EPA's Mobile 5a model, with inputs as shown in Appendix IV, an emission reduction of 81 tons per day of VOCs was achieved.

7.4.3 REFORMULATED GASOLINE

Background:
This program requires the use of lower polluting "reformulated" gasoline in the Philadelphia CMSA. This will affect all gasoline powered vehicles and will also reduce evaporative emissions from service stations.

At a minimum, reformulated gasoline must not cause an increase in NOx emissions, have an oxygen content of at least 2.0 percent by weight, have a benzene content no greater than 1.0 percent by volume, contain no heavy metals and contain detergents. Most importantly, the Act requires a reduction in VOC and toxic emissions of 15 percent over baseline levels beginning in 1995 and 25 percent beginning in the year 2000.

Implementation:
This is a federally implemented program. This program will begin on January 1, 1995.

Target Reductions:
Use of reformulated gasoline is expected to reduce VOC emissions by 38 tpsd in the Philadelphia CMSA for highway vehicles.

7.4.4 EMPLOYER TRIP REDUCTION (ETR)

Background:
The Clean Air Act Amendments[12] requires Pennsylvania to implement an ETR program. Pennsylvania has adopted a regulation requiring employers with 100 employees or more at a worksite to develop and submit trip reduction plans and to reduce their employees' trips to a specified target Average Passenger Occupancy (APO) level. The Philadelphia nonattainment area is divided into four APO target

areas, which overall will lead to a 25 percent increase in APO over the nonattainment area.

Implementation:
The regulations require employers to survey employees arriving between 6 and 10 AM during a typical workweek between April 1 and September 30. Employers must submit a plan which demonstrates compliance according to the following schedule:

- Employers of 1000 employees and above must achieve at least 50 percent of the APO increases during the 1995 survey period, 80 percent during 1996 and 100 percent during 1997.
- Employers of fewer than 1000 employees must achieve at least 50 percent of the APO increases during the 1996 survey period and 100 percent during 1997.
- Larger employers are required to submit a plan by November 15, 1994 and smaller employers by November 15, 1995.

The state regulations adopted for the implementation of ETR provide for a gradual attainment of goals by employers, with no banking allowed. As a result, by 1996, only partial attainment (80% for large employers, 50% for small employers) will have been realized.

A Traffic Demand Model (TDM) was used to estimate the effects of these programs, through the following steps:

1. Partial trip tables were developed comprising travel to each of the four zones.
2. Trip reduction goals were established for each zone separately for employers of 1000+ and 100-999, prorated to partial goal attainment (80% and 50%, respectively).
3. The TDM was run for each employer/zone (8 scenarios), to identify an employer TDM program that would achieve the respective trip reduction goal. Efforts were made to make these programs as consistent as possible across situations, and as independent of pricing measures as possible.
4. Trip reduction associated with each of the employer/AVO situations were then bundled together into a regional travel impact estimate in the form of a modified set of regional trip tables.
5. The revised trip tables were merged with total trips and sent to the Delaware Valley Regional Planning Commission (DVRPC) and were used by the Post Processor for Air Quality (PPAQ) to generate inputs for Mobile 5a.

Target Reductions:
Emission reductions calculations show a reduction of 1 tons per day of VOCs can be expected from this program in 2005.

8.0 CONTINGENCY MEASURES

Background:
States are required[13] to have specific contingency measures that will take effect with minimal further action by the state or the EPA if the state fails to reduce VOC emissions 42 percent by November 15, 2005, or if any of the state's nonattainment areas fail to meet the emission reduction milestones or NAAQS prescribed by the Act.

The contingency measures identified by the state must be sufficient to secure an additional 3 percent reduction in ozone precursor emissions in the year following the year in which the failure has been identified. If the shortfall is less than 3 percent, a contingency measure need only cover that smaller percentage. If the shortfall is greater than 3 percent, the state, in an annual tracking report, must either identify the additional actions it will take to cure the shortfall before the next milestone or maintain a reserve of contingency measures capable of covering a shortfall greater than 3 percent. Early implementation of an emission reduction measure to be carried out in the future is acceptable as a contingency measure.

Reductions in NOx can be substituted for a portion of the required VOC reductions. In this case, the NOx inventory must be reduced by an percent equivalent to the percentage VOC reductions it replaces.

This contingency plan is required to show measures sufficient to obtain a reduction of 18 tpsd of VOC, or a combination of VOC and NOx controls showing equivalent reductions.

This plan shows emission reductions that exceed the 42% requirement by 44 tpsd. This excess is being applied in lieu of additional strategies in this contingency plan.